

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

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Applicant's or agent's file reference AJC/P101253WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/GB 03/05238	International filing date (day/month/year) 02.12.2003	Priority date (day/month/year) 05.12.2002
International Patent Classification (IPC) or both national classification and IPC C25C3/00		
Applicant BRITISH NUCLEAR FUELS PLC et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.
 - ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

- This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 01.07.2004	Date of completion of this report 03.05.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Bjoerk, P Telephone No. +49 89 2399-8452



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/GB 03/05238**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-7 as originally filed

Claims, Numbers

1-11 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

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EXAMINATION REPORT**

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**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-11
	No: Claims	
Inventive step (IS)	Yes: Claims	1-11
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-11
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB 03/05238

1. The application relates to a method suitable for the separation of metals from mixtures of metal oxides comprising oxides of metals from the transition metal series or from the lanthanide or actinide series. The method comprises adding the mixed oxide to a molten salt electrolyte and cathodically electrolysing the oxide in such a way that certain metals are selectively reduced over the others. The reduced metal is then separated from the remaining metal oxides.

A preferred metal oxide mixture is zirconium and hafnium oxides (claim 3) and the preferred molten salt CaCl_2 or BaCl_2 (claim 7).

2. Reference is made to the following documents:

D1: WO-A-01/41152

D2: WO-A-02/066712

D3: US-A-4 762 694

D1 is cited in the description and discloses a process for reducing to metallic form a metal oxide present in spent nuclear fuel, such as mixed uranium/plutonium oxide fuel pellets (claim 3). The potential of the cathode is controlled as to favour oxygen ionisation over deposition of the metal from the cations present in the molten salt (claim 1). The reduced metal is later used as the feed for an electrorefining process which may be carried out in the same electrolytic cell as the electrolytic reduction process (claims 10 and 11).

D2 relates to an electrorefining process using an electrolyte comprising molten salt. D2 teaches that selective electrodeposition is achieved by applying a suitable potential at the cathode. In the case of uranium from irradiated nuclear fuel, uranium and less electropositive metals are deposited first. As there usually are no less electropositive metals dissolved, only uranium will deposit, leaving the other metals in the anodic sludge (p.10, l.23 - p.11, l.13).

D3 discloses a molten salt extraction process of metals from low grade ores and ocean-floor nodules. The metal oxides are converted to chlorides in a molten salt and then subjected to selective distillation, electrolysis and precipitation (claim 1). In example 1, the molten salt is a mixture of NaCl , KCl and MgCl_2 , the distillation step

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removes iron and copper chlorides and the electrolysis is carried out at about -0.1 volt and -0.3 volt versus Ag/AgCl for deposition of nickel and cobalt on separate graphite cathodes.

3. The present application applies the electroreduction method of D1 to a mixture of metal oxides with the aim to separate the metals from each other. Whereas D1 does mention a mixture of uranium and plutonium oxides, it is not unambiguously derivable from D1 that one metal is reduced and separated while the other one remains as a metal oxide.

D2 does not teach oxygen ionisation instead of metal deposition as presently claimed and the process of D3 converts metal oxides into chlorides instead of electroreducing.

Consequently, the requirement of novelty of Art.33(2) PCT is seen as fulfilled by the subject matter of claim 1 and, due to direct dependency, by that of its dependant claims 2 to 11.

4. There is no incentive from D2 or D3 to apply the electroreduction method of D1 to a separation process of metals originating from a mixture of metal oxides.

Consequently, the requirement of inventive step of Art.33(3) PCT is seen as fulfilled by the subject matter of claims 1 to 11.